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A SPECIAL REPORT SERIES BY THE N.C. DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES
STATE CENTER FOR HEALTH AND ENVIRONMENTAL STATISTICS
P.O. BOX 29538, RALEIGH, N.C. 27626-0538

No. 73 May 1993

PREGNANCY COMPLICATIONS AND PERINATAL OUTCOMES ASSOCIATED WITH MATERNAL DIABETES

by

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ABSTRACT

This study examines the risk for maternal complications and adverse outcomes among a cohort of 6,092 diabetic (insulin-dependent and non-insulin-dependent) and 13,653 nondiabetic gravidas delivering in North Carolina in 1989-1990. Data on maternal diabetes and pregnancy outcome were obtained from matched live birth and infant death certificates.

Controlling for maternal age, race, education, marital status, parity, smoking, and amount of prenatal care, mothers with diabetes were more likely to have had complications of polyhydramnios, pregnancy-induced hypertension, eclampsia, cephalopelvic disproportion, breech presentation and preterm delivery. Infants of diabetic mothers were more likely to weigh 4,000 grams or more at delivery and to experience birth injury and intrapartum hypoxemia. Controlling for birth weight, the risk for neonatal and postneonatal mortality among infants of diabetics was more than two times that of infants whose mothers were nondiabetic. Congenital malformations accounted for 31.3 percent of the deaths among infants of diabetic mothers, compared to 11.6 percent of the deaths among infants of nondiabetics.

These findings indicate that diabetes is associated with a wide spectrum of maternal and perinatal complications. Appropriate preconceptional care, improved prenatal diagnosis, better metabolic control, and careful obstetric management of mothers with diabetes can substantially reduce the risk for many of these conditions.

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INTRODUCTION

Diabetes is associated with a high rate of pregnancy complications and poor perinatal outcomes. The likelihood and severity of adverse outcomes is generally much greater for mothers with established (preconceptional) diabetes than for those with gestational diabetes. Estimates of the percentage of pregnancies complicated by diabetes vary widely, depending on the screening and diagnostic criteria employed.[1] For most obstetric populations, the prevalence of maternal diabetes is probably about one to five percent. About 80 to 90 percent of these cases involve gestational diabetes, with the remainder occurring among mothers with preconceptional diabetes.[1,2] Comparison of prevalence estimates and major determinants of diabetes among different patient populations is problematic due to the lack of consistency regarding the diagnosis and classification of diabetes.

A number of studies have examined the risks for adverse maternal and perinatal outcomes associated with diabetic pregnancies.[3-7] Most of these analyses have been hospital-based studies conducted in large tertiary care centers. Because of the selectiveness in referral patterns and the quality of prenatal and obstetric care available to the patients at these facilities, extrapolation of these findings to other clinical populations is often difficult. Due to the paucity of data from well-controlled, population-based studies, the spectrum of adverse outcomes--and the magnitude of risk associated with these outcomes--among diabetic mothers in the general obstetric population is not well understood. The purpose of this study is to examine the risk of maternal complications and adverse pregnancy outcomes among all mothers in North Carolina diagnosed with preconceptional or gestational diabetes, as reported on the birth certificate.

METHODS

All North Carolina resident singleton live births delivered in 1989-1990 were identified from computerized matched live birth and infant death records. All birth records with an indication of diabetes were selected for study. The presence of diabetes was ascertained from a checkbox item in the medical history section on the birth certificate. Because the birth record does not distinguish preconceptional from gestational diabetes, a positive history of diabetes would have been reported for mothers with either form of the disease. From the remaining eligible live births with no mention of diabetes, a seven percent computer-generated random sample was selected for comparison.

Data on maternal and perinatal complications, as well as potential confounding variables, were obtained from the birth certificate. For infants who died prior to one year of age, the infant's age at death and underlying cause of death were ascertained from the matched death certificate. To identify infants who were delivered preterm (<37 completed weeks gestation), gestational age was estimated from the date of the last menstrual period (LMP), as reported on the birth certificate. For those cases in which the LMP dates were incomplete, or in which the estimated gestational age was clearly inconsistent with the infant's birth weight, the clinical estimate of gestational age was used.

Logistic regression[8] was used to determine odds ratios (ORs) and 95 percent confidence intervals (CIs) for the association between diabetes and selected pregnancy outcomes, controlling for other risk factors. Confounding variables analyzed included mother's age, race, education, marital status, parity, tobacco use, and adequacy of prenatal care (as determined by the Kessner Index[9]). Patterns in cause-specific infant mortality were also examined for diabetic and nondiabetic pregnancies. Infant mortality risks (infant deaths per 1,000 live births) were computed for selected cause-of-death categories and for all causes. Computationally this measure is identical to the infant mortality *rate*; however, we use the term "risk" because the data reflect the number of infant deaths in a birth cohort rather than the number of infant deaths and live births occurring during a specific year.[10] Because of the substantial underreporting of congenital malformations on the birth certificate,[11] in this analysis we did not attempt to examine the risk for specific birth defects associated with maternal diabetes.

RESULTS

Between January 1, 1989 and December 31, 1990, there were 201,823 singleton live births to North Carolina residents. Of these, 6,092 (3.0 percent) had a history of diabetes noted on the birth certificate, and were selected for study. A random sample of 13,653 nondiabetic mothers delivering in 1989 and 1990 was selected for comparison. Less than one percent of the birth certificates had missing information on diabetes; these records were excluded from all analyses.

Diabetic mothers were, on average, slightly older than the nondiabetic mothers in our sample. The mean age of diabetic mothers was 28.3 years compared to 25.3 years for the controls ($p < 0.001$). Compared to the nondiabetics, the diabetic women were more likely to be white, married, multiparous, and to have had at least a high school education (Table 1). In a previous study,[2] we found that the associations between diabetes and marital status, parity, and education were confounded by maternal age; when controlled for age, women with a high school education or parity 1-2 showed no increased risk for diabetes, while parity of three or more was actually inversely associated with the risk for diabetes.

A substantially higher percentage of the diabetics than the nondiabetics had an adequate Kessner Index (81.9 percent versus 71.0 percent). Also, only three percent of the diabetic mothers received an inadequate Kessner score, compared to eight percent of the nondiabetic women. Much of this difference is probably due to the tendency for diabetic mothers to have received more prenatal visits as a result of their illness. Also, it is likely that diabetic women who received regular prenatal visits would have had a greater opportunity of being diagnosed with the condition, compared to those diabetics who had received fewer than the recommended number of visits.

There was no difference in the proportion of mothers who smoked among diabetics and nondiabetics. About 21 percent of the mothers in each group were reported as having smoked cigarettes.

Diabetic mothers generally had a higher frequency of maternal complications compared to nondiabetics (Table 2). After controlling for confounding factors, diabetics were 1.8 times as likely as nondiabetics to have had polyhydramnios. Pregnancy-induced hypertension was the most frequently reported maternal complication among diabetic mothers. The odds for pregnancy-induced hypertension among diabetics were more than two times that of nondiabetics. Diabetic mothers were twice as likely as nondiabetics to have had reported eclampsia. When controlled for extraneous factors, the risk for eclampsia increased to 2.3. In contrast, the risk for bleeding during pregnancy was 30 percent lower among the diabetic mothers than among the controls. This risk was unchanged after adjusting for confounding variables. There was no association between diabetes and the risk for premature rupture of membranes.

Diabetes was not associated with an increased risk for placenta previa, placental abruption, dysfunctional labor or fetal distress, after controlling for possible confounding factors (Table 2). In contrast, the odds for fetal malpresentation and cephalopelvic disproportion were increased among the diabetic mothers compared to the nondiabetics. These associations diminished only slightly when adjusted for other risk factors. The frequency of preterm delivery was similar for both diabetic and nondiabetic women (11.1 percent and 10.7 percent, respectively), resulting in an unadjusted odds ratio of 1.0. However, when controlled for other risk factors, the odds ratio increased to 1.2 and was significantly greater than unity.

A variety of adverse outcomes were also evident among the infants of diabetic mothers (Table 2). Fetal macrosomia (birth weight $\geq 4{,}000$ g) was the most commonly observed outcome in both groups, occurring among 17.2 percent of the diabetic mothers and 11.5 percent of the controls. Controlling for extraneous factors, the odds for a diabetic woman delivering an infant weighing 4,000 g or more were 1.5 times the odds for nondiabetics. Related to the increased frequency of fetal macrosomia among diabetics, infants of diabetic mothers were nearly twice as likely as the control infants to experience physical trauma during labor and delivery. In addition, infants of diabetic mothers were at increased risk for intrapartum hypoxemia: these infants were more likely than the controls to have received assisted ventilation and to have had one-minute Apgar scores of six or less. There was no association between diabetes and five-minute Apgar scores of six or less. Diabetes was also associated with elevated but statistically nonsignificant risks for hyaline membrane disease and meconium aspiration syndrome.

In addition to the increased likelihood for perinatal morbidity, maternal diabetes was associated with increased risks for infant mortality when the effects of extraneous factors were controlled (Table 2). Infants of diabetic mothers were 1.3 times as likely to die during the neonatal period, compared to control infants. The risk for postneonatal death among infants of diabetic mothers was nearly twice that of controls, while the risk for infant mortality overall (neonatal plus postneonatal deaths) was 50 percent higher than that of the controls. Because of the disparity in birth weight distributions between the diabetic and control subjects, we also examined the association between diabetes and infant death controlling for birth weight in addition to the other covariates (results not shown). After adjusting for birth weight, the odds ratio for neonatal death among infants of diabetic mothers increased to 2.1 (95 percent CI 1.3-3.5). The risk for postneonatal mortality increased only slightly when birth weight was controlled (adjusted OR = 2.1, 95 percent CI 1.2-3.7). Controlling for birth weight, the relative risk for infant mortality overall among diabetics was 2.1 (95 percent CI 1.5-3.0).

The pattern of cause-specific infant mortality also differed between the diabetic and nondiabetic subjects (Table 3). Among infants of diabetic mothers, the risk for mortality from congenital malformations was more than three times that of infants in the control group. Sixty-five percent (n=13) of the deaths attributed to congenital malformations among the infants of diabetic mothers were due to cardiac anomalies, including three infants with hypoplastic left heart. Four of the deaths among the infants of diabetics were attributed to birth asphyxia and four were attributed to apnea, while only two such deaths were reported among the control infants. Despite the higher risk for preterm delivery among the diabetic subjects, the risk for infant death due to extreme immaturity was slightly lower among the diabetic group than among the controls. There was little difference in the risk for sudden infant death among the diabetic and nondiabetic subjects.

DISCUSSION

Despite differences in diagnosis/classification of diabetes, study populations, and analytic methods, our results are generally similar to previously reported findings from hospital-based studies. However, the present analysis suggests that diabetes mellitus may be associated with a broader array of adverse outcomes than has been reported in many of the clinical studies. Part of this difference may be related to the heterogeneity of maternal diabetes as defined in our analysis; mothers with mild forms of gestational diabetes, as well as women with more advanced stages of diabetes, all are included in the diabetic group. It is well established that both the nature and the seriousness of pregnancy complications among diabetic patients depends largely on the severity of the disease. For example, while fetal macrosomia is one of the most frequent complications associated with gestational diabetes, insulin-dependent diabetic women with severe cardiovascular disease may be more likely to deliver an infant manifesting evidence of fetal growth restriction. Also, because the women in this study were selected from a population-based sample of all North Carolina resident births, the quality of obstetric care and degree of metabolic control is likely to have been much more variable among these mothers compared to a study sample which had been selected exclusively from a tertiary perinatal center. Descriptive data from most of the larger hospital-based analyses suggest that the diabetic patients in those studies generally received excellent obstetric care and diabetic management. In contrast, in our study 18 percent of the diabetic mothers received less than adequate prenatal care, as determined by the Kessner index.

For women with either preconceptional or gestational diabetes, one of the most consistently observed associations in the literature is an increased risk for fetal macrosomia.[4,5,12-14] Large-for-gestational-age infants are reported in 18-25 percent of diabetic pregnancies. These findings are consistent with our observations. It has been argued that the excessive somatic growth of the fetus in diabetic pregnancies is related primarily to maternal hyperglycemia.[15] The fact that an increased risk for macrosomia persists even with apparently adequate maternal glycemic control suggests that other factors may also be involved.[12]

Our observation of a significantly increased risk for pregnancy-induced hypertension associated with diabetes is also in agreement with other reports.[3] There is some question as to whether this increased risk is related to underlying vascular disease or to poor glycemic control among diabetics.[4] We carried out a separate analysis on the risk for pregnancy-induced hypertension, excluding subjects with chronic hypertension, heart disease, or renal disease, and found little change in the results (adjusted OR = 2.3, 95 percent CI 2.0-2.6), suggesting that this increased risk is not due to the presence of these pre-existing conditions. In contrast, Jacobson and Cousins[4] found no increased risk for pregnancy-induced hypertension among women with gestational diabetes, after excluding subjects with chronic hypertension or kidney disease. However, the diabetic patients in that study had been closely monitored through a comprehensive diabetes management program aimed at achieving adequate euglycemic control. These observations suggest that careful maternal glucose control may reduce the risk for pregnancy-induced hypertension among some diabetic patients.

In this study, women with diabetes were 2.3 times as likely as nondiabetics to have had reported eclampsia, independent of maternal age, parity, and other potential confounding factors. Previous studies suggest a two- to four-fold increased risk for preeclampsia among gestational diabetics, and a ten-fold greater risk among women with established diabetes.[7,16]

While several studies have reported an increased likelihood of perinatal death among women with insulin-dependent diabetes, the present data also indicate a two-fold increased risk for postneonatal mortality among infants of diabetic mothers, after controlling for confounding factors. Most of this increased risk in postneonatal death was due to an increase in mortality due to congenital malformations, particularly cardiac anomalies. No remarkable difference in the risk for SIDS or other causes of death was apparent among the diabetic and nondiabetic subjects. The elevated risk for mortality due to congenital anomalies among infants of diabetic mothers is consistent with reports from other studies which found an increased risk for major malformations in diabetic pregnancies.[14,17,18]

There are several limitations of this analysis that need to be considered. For almost all of the pregnancy outcomes examined here, the level of risk associated with diabetes will vary depending on the time of diabetes onset, severity of the disease, and level of glucose control. Because this analysis included mothers with all types of diabetes, the odds ratios presented here are likely to underestimate the risk for certain adverse outcomes among mothers with very severe or poorly controlled diabetes, and to overestimate the risk associated with gestational diabetes or other milder forms of the disease. An earlier study using hospital discharge records in North Carolina suggested that approximately 79 percent of the reported cases of diabetes among maternity patients delivering in the state are of the gestational type.[2] Assuming a similar proportion of gestational diabetics in the present analysis, it is possible that the odds ratios for many of the outcomes examined here would more closely reflect the level of risk associated with gestational rather than preconceptional diabetes. Additional studies are needed to better characterize the relative risk for specific perinatal complications among patients with different types or levels of severity of diabetes mellitus.

Another limitation of this study concerns the potential for underreporting of diabetes and other maternal and infant conditions on the birth certificate. Diabetes was reported in three percent of live births in our data, compared to 2.1 percent for all U.S. live births in 1989.[19] Earlier analyses suggested that, in North Carolina, the level of reporting of diabetes on the birth certificate is comparable to that of hospital discharge reports.[2] While some underreporting of diabetes in each of these data sources must be acknowledged, the level of ascertainment appears to be acceptable for most exploratory analyses of this type. For other information reported on the birth certificate, the data quality is somewhat inconsistent. Most of the maternal demographic variables seem to be very well reported, while data related to complications of labor and delivery and abnormal conditions of the newborn appear to be substantially underreported when compared to mother's medical records.[11]

Of greater concern than the general underascertainment of pregnancy complications and other adverse outcomes on the birth certificate is the potential for differential reporting of these conditions between women with and without an indication of diabetes noted on the record. For example, it is possible that the individual who completes the birth certificate may be more likely to actively search for and record other maternal and infant complications noted in the medical record, if a history of diabetes is indicated in the record. Similarly, the presence of abnormalities in the newborn such as severe asphyxia, macrosomia, or certain congenital malformations may prompt a more thorough search of the medical record for a history of diabetes. Such a reporting bias would tend to inflate some of the risks observed in this study. However, the fact that most of the observed associations were consistent with reports from prospective clinical studies supports the validity of the present findings.

The results of this population-based analysis suggest that, despite recent improvements in the diagnosis and management of diabetes, diabetic mothers and their infants remain at increased risk for a wide variety of adverse outcomes and pregnancy complications. Many of these conditions--notably preeclampsia, congenital malformations, perinatal mortality, and birth injury--may be prevented or successfully managed through risk-appropriate preconceptional and obstetric care.[20,21] For this reason, it is important that the diabetic patient receive appropriate counseling from her physician regarding the risk for adverse pregnancy outcomes and the need to maintain strict metabolic control in order to maximize her chances of a healthy pregnancy outcome.

ACKNOWLEDGMENTS

This research was supported by a cooperative agreement with the Division of Diabetes Translation, Centers for Disease Control. We thank Ms. Kathryn Surles and Dr. Andrew Olshan for their review and comments. We also thank Ms. Jean Stafford for her assistance in preparing the manuscript.

REFERENCES

1. Merchant RH, Dalvi R, Vidwans A. Infant of the diabetic mother. Indian Pediatr 1990;27:373-79.

2. Meyer RE, Buescher PA, Sullivan LA. Diabetes in pregnancy in North Carolina. CHES Studies Report No. 64. State Center for Health and Environmental Statistics, Raleigh, North Carolina, May, 1992.

3. Cousins L. Pregnancy complications among diabetic women: review 1965-1985. Obstet Gynecol Surv 1987;42:140-49.

4. Jacobson JD, Cousins L. A population-based study of maternal and perinatal outcome in patients with gestational diabetes. Am J Obstet Gynecol 1989;161:981-86.

5. Johnstone FD, Nasrat AA, Prescott RJ. The effect of established and gestational diabetes on pregnancy outcome. Br J Obstet Gynaecol 1990;97:1009-15.

6. Roberts AB, Pattison NS. Pregnancy in women with diabetes mellitus, twenty years experience: 1968-1987. NZ Med J 1990;103:211-13.

7. Heckbert SR, Stephens CR, Daling JR. Diabetes in pregnancy: maternal and infant outcome. Paediatr Perinat Epidemiol 1988;2:314-26.

8. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research: Principles and Quantitative Methods. New York: Lifetime Learning Publications, 1982.

9. Kessner DM, Singer J, Kalk CE, Schlesinger ER. Infant death: an analysis by maternal risk and health care. In Contrasts in Health Status, Vol 1. Washington, DC: Institute of Medicine, National Academy of Sciences, 1973.

10. Buehler JW, Strauss LT, Hogue CJ, Smith JC. Birth weight-specific causes of infant mortality, United States, 1980. Pub Health Rep 1987;102:162-71.

11. Buescher PA, Pinnex KV, Davis MH, Bowling JM. Quality of the new birth certificate data: A follow-back study in North Carolina. CHES Studies Report No. 68. State Center for Health and Environmental Statistics, Raleigh, North Carolina, June, 1992.

12. Berk MA, Mimouni F, Miodovnik M, Hertzberg V, Valuck J. Macrosomia in infants of insulin-dependent diabetic mothers. Pediatr 1989;83:1209-34.

13. Lindsay MK, Graves W, Klein L. The relationship of one abnormal glucose tolerance test value and pregnancy complications. Obstet Gynecol 1989;73:103-6.

14. Hod M, Merlob P, Friedman S, Rusecki Y, Schoenfeld A, Ovadia J. Prevalence of congenital anomalies and neonatal complications in the offspring of diabetic mothers in Israel. Isr J Med Sci 1991;27:498-502.

15. Pedersen J. Weight and length at birth of infants of diabetic mothers. Acta Endocrinol 1954;16:330-42.

16. Garner PR, D'Alton ME, Dudley DK, Huard P, Hardie M. Preeclampsia in diabetic pregnancies. Am J Obstet Gynecol 1990;163:505-8.

17. Becerra JE, Khoury MJ, Cordero JF, Erickson JD. Diabetes mellitus during pregnancy and the risks for specific birth defects: a population-based case-control study. Pediatrics 1990;85:1-9.

18. Centers for Disease Control. Perinatal mortality and congenital malformations in infants born to women with insulin-dependent diabetes mellitus - United States, Canada, and Europe, 1940-1988. MMWR 1990;39:363-65.

19. National Center for Health Statistics. Advance report of new data from the 1989 birth certificate. Monthly Vital Statistics Report, vol 40 no 12, suppl. Hyattsville: US Public Health Service, 1992.

20. Jovanovic L, Peterson C. Management of the pregnant insulin-dependent diabetic woman. Diabetes Care 1980;3:63-8.

21. Fuhrmann K, Reiher H, Semmler K, Fischer F, Fischer M, Glockner E. Prevention of congenital malformations in infants of insulin-dependent diabetic mothers. Diabetes Care 1983;6:219-23.

TABLE 1
CHARACTERISTICS OF STUDY POPULATION, 1989-1990 NORTH CAROLINA RESIDENT SINGLETON LIVE BIRTHS.

Characteristic	DIABETIC (n=6,092) Number (%)	NONDIABETIC (n=13,653) Number (%)	Odds Ratio	(95% CI)
Race				
Black & Other	1,609 (26.4)	4,392 (32.3)	1.0	
White	4,483 (73.6)	9,260 (67.8)	1.3	(1.2-1.4)
Unknown	0	1		
Marital Status				
Single	1,055 (17.3)	3,928 (28.8)	1.0	
Married	5,037 (82.7)	9,724 (71.2)	1.9	(1.8-2.1)
Unknown	0	1		
Parity				
Nulliparous	2,512 (41.3)	6,212 (45.5)	1.0	
Parity 1-2	3,119 (51.2)	6,578 (48.2)	1.2	(1.1-1.3)
Parity ≥ 3	459 (7.5)	855 (6.3)	1.3	(1.2-1.5)
Unknown	2	8		
Education				
< HS Education	1,007 (16.5)	3,143 (23.0)	1.0	
≥ HS Education	5,079 (83.5)	10,493 (77.0)	1.5	(1.4-1.6)
Unknown	6	17		
Kessner Index				
Adequate	4,936 (81.9)	9,594 (71.0)	1.0	
Intermediate	912 (15.1)	2,844 (21.0)	0.6	(0.6-0.7)
Inadequate	181 (3.0)	1,074 (8.0)	0.3	(0.3-0.4)
Unknown	63	141		
Tobacco Use				
Nonsmoker	4,828 (79.5)	10,766 (79.1)	1.0	
Smoker	1,244 (20.5)	2,850 (20.9)	1.0	(0.9-1.1)
Unknown	20	37		

TABLE 2
UNADJUSTED AND ADJUSTED ODDS RATIOS AND 95% CONFIDENCE INTERVALS FOR PREGNANCY COMPLICATIONS AND ADVERSE OUTCOMES ASSOCIATED WITH MATERNAL DIABETES, 1989-1990 NORTH CAROLINA RESIDENT SINGLETON LIVE BIRTHS.

Condition	DIABETIC (n=6,092) Number (%)	NONDIABETIC (n=13,653) Number (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
MATERNAL COMPLICATIONS				
Polyhydramnios	58 (1.0)	76 (0.6)	1.7 (1.2-2.4)	1.8 (1.3-2.6)
PIH	434 (7.1)	475 (3.5)	2.1 (1.9-2.4)	2.1 (1.9-2.5)
Eclampsia	62 (1.0)	72 (0.5)	1.9 (1.4-2.7)	2.3 (1.6-3.3)
Uterine bleeding	71 (1.2)	220 (1.6)	0.7 (0.6-0.9)	0.7 (0.5-0.9)
PROM	278 (4.6)	547 (4.0)	1.1 (0.9-1.3)	1.1 (0.9-1.3)
COMPLICATIONS OF LABOR AND DELIVERY				
Placenta previa	25 (0.4)	45 (0.3)	1.2 (0.8-2.0)	0.9 (0.5-1.5)
Placental abruption	39 (0.6)	96 (0.7)	0.9 (0.6-1.3)	0.9 (0.6-1.3)
Dysfunctional labor	420 (6.9)	823 (6.0)	1.2 (1.0-1.3)	1.1 (1.0-1.3)
Malpresentation	309 (5.1)	468 (3.4)	1.5 (1.3-1.7)	1.4 (1.2-1.6)
CPD	346 (5.7)	566 (4.2)	1.4 (1.2-1.6)	1.3 (1.1-1.5)
Fetal distress	435 (7.2)	869 (6.4)	1.1 (1.0-1.3)	1.1 (1.0-1.3)
Preterm delivery	670 (11.1)	1,448 (10.7)	1.0 (0.9-1.1)	1.2 (1.1-1.3)
ADVERSE OUTCOMES OF NEWBORN/INFANT				
Birth wt. ≥ 4,000g	992 (17.2)	1,460 (11.5)	1.6 (1.5-1.7)	1.5 (1.4-1.6)
Birth injury	29 (0.5)	35 (0.3)	1.9 (1.1-3.1)	1.9 (1.1-3.1)
1-Minute Apgar ≤ 6	646 (10.6)	1,111 (8.2)	1.3 (1.2-1.5)	1.4 (1.3-1.6)
5-Minute Apgar ≤ 6	107 (1.8)	209 (1.5)	1.1 (0.9-1.4)	1.2 (1.0-1.6)
Infant ventilation	284 (4.7)	415 (3.0)	1.6 (1.3-1.8)	1.6 (1.4-1.9)
HMD/RDS	44 (0.7)	77 (0.6)	1.3 (0.9-1.9)	1.4 (0.9-2.0)
MAS	16 (0.3)	24 (0.2)	1.5 (0.8-2.8)	1.5 (0.8-3.0)
Infant death	64 (1.1)	112 (0.8)	1.3 (0.9-1.7)	1.5 (1.1-2.1)
Neonatal	38 (0.6)	73 (0.5)	1.2 (0.8-1.7)	1.3 (0.9-2.0)
Postneonatal	26 (0.4)	39 (0.3)	1.5 (0.9-2.5)	1.9 (1.1-3.3)

PIH = pregnancy-induced hypertension, PROM = premature rupture of membranes, CPD = cephalopelvic disproportion, HMD/RDS = hyaline membrane disease/respiratory distress syndrome, MAS = meconium aspiration syndrome.

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TABLE 3
CAUSE-SPECIFIC INFANT MORTALITY RISKS AMONG DIABETIC AND NONDIABETIC PREGNANCIES, 1989-1990 NORTH CAROLINA RESIDENT SINGLETON LIVE BIRTHS.

	DIABETIC (n=6,092)		NONDIABETIC (n=13,653)	
Cause of Death	Number Deaths	Mortality Risk[1]	Number Deaths	Mortality Risk
Congenital Malformations	20	(3.3)	13	(1.0)
Central nervous system	3	(0.5)	1	(0.1)
Cardiac/Circulatory	13	(2.1)	7	(0.5)
Other	4	(0.7)	5	(0.4)
Other Perinatal Conditions	21	(3.5)	63	(4.6)
Immaturity/Preterm	5	(0.8)	16	(1.2)
RDS	2	(0.3)	9	(0.7)
Birth Asphyxia	4	(0.7)	1	(0.1)
Apnea	4	(0.7)	1	(0.1)
Other	6	(1.0)	36	(2.6)
SIDS	9	(1.5)	19	(1.4)
All Other Causes	14	(2.3)	17	(1.2)
Total	64	(10.5)	112	(8.2)

[1] Infant deaths per 1,000 live births.
RDS = Respiratory distress syndrome

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